

CLAIMS

What I claim is:

- 1 1. A method for insitu minimization of infiltration and exfiltration of underground
2 pipes comprising the following steps:
 - 3 a) forming an elastically coillable and radially expandable support having a
4 diameter when in a relaxed state;
 - 5 b) coiling the support to a reduced diameter under tension;
 - 6 c) inserting the tensioned coiled support into an interior annulus of a pipe
7 where a first inner surface of the pipe wall has a diameter smaller than the
8 outer diameter of the support in a relaxed state;
 - 9 d) releasing the tension of the support when at a selected location; and
 - 10 e) expanding the outer diameter of the support to contact the inner surface of
11 the pipe wall forming the interior pipe diameter.
- 1 2. The method of claim 1 further comprising the step of incorporating a thermally
2 responsive material with the support.
- 1 3. The method of claim 2 further comprising the step of impregnating the
2 support with the thermally responsive material.
- 1 4. The method of claim 1 comprising the step of incorporating a partially cured
2 thermally responsive material.
- 1 5. The method of claim 4 further comprising the step of impregnating the support
2 with the partially cured thermally responsive material.
- 1 6. The method of claim 1 further comprising the step of incorporating an
2 electrical conductor with the support with separable connections to an
3 electrical power source.
- 1 7. The invention of claim 6 wherein the material contains electrically conductive
2 elongated components.
- 1 8. The method of claim 7 wherein the elongated components are carbon fibers.
- 1 9. The method of claim 1 further comprising constructing the support with
2 electrically conductive material.

- 1 10. The method of claim 9 further comprising constructing the support with a
2 metal.
- 1 11. The method of claim 1 further comprising heating the support after release of
2 tension.
- 1 12. The method of claim 9 wherein the heat is created by electrical resistivity or
2 impedance of the support.
- 1 13. The method of claim 2 further comprising the step of pressing the thermally
2 reactive material into surficial voids and undulations of the first inner pipe wall
3 after release of tension.
- 1 14. The method of claim 4 further comprising the step of pressing the partially
2 cured chemical reactant into surficial voids and undulations of the first inner
3 pipe wall after release of tension.
- 1 15. The method of claim 11 further comprising the step of curing the reactant and
2 rigidizing the support to form a solid inner layer proximate to the first inner
3 pipe wall.
- 1 16. The method of claim 1 further comprising the use of the injecting at least one
2 chemical reactant into the ground to form a reaction product.
- 1 17. The method of claim 16 further comprising the step of creating a closed cell
2 foam reaction product.
- 1 18. The method of claim 16 wherein the reaction product reduces spaces within
2 the ground and between the ground and a second outer pipe wall surface.
- 1 19. The invention of claim 16 wherein the reactant is selected from a group
2 consisting of a hybrid polyurethane or polyester/polyurethane blend resin, and
3 epoxy resins combined with diluents, catalysts, blowing agents and
4 surfactants, an acrylimide, and cementitious slurry.
- 1 20. The method of claim 16 wherein the radial expansion of the relaxed material
2 minimizes the infiltration of the reactant and reaction product into the pipe.
- 1 21. A method for insitu minimization of infiltration and exfiltration of underground
2 pipes having thickness between a first inner surface and a second outer
3 surface comprising the following steps:

- 4 a. inserting into the pipe a heatable and radially expandable tensioned coil
- 5 support containing thermal responsive material in communication with the
- 6 ground surface;
- 7 b. releasing the tension to allow an outer surface of the support to press the
- 8 to the first inner surface of the pipe;
- 9 c. Injecting a reactant into the ground; and
- 10 d. heating the coil to radiate heat through the thickness of the pipe to the
- 11 ground proximate to the second outer surface.
- 1 22. The method of claim 21 further comprising radiating heat to create a reaction
- 2 product of expanding close cell foam.
- 1 23. The method of claim 21 further comprising heating the ground proximate to
- 2 the second outer surface of the pipe prior to insertion of the reactant.
- 1 24. The method of claim 21 further comprising rigidizing the thermal-responsive
- 2 material while pressed to the first interior surface of the pipe.
- 1 25. The method of claim 23 further comprising shortening the cure time of the
- 2 injected chemical reactant foam proximate to second outer surface is
- 3 shortened.
- 1 26. The method of claim 21 further comprising removing the support after the
- 2 rigidizing the thermal-responsive material.
- 1 27. The method of claim 26 further comprising the step of recoiling the support
- 2 into a smaller diameter prior to removal from the pipe.
- 1 28. The method of claim 21 further comprising placing a radially inward tensioned
- 2 support on the second outer pipe wall surface.
- 1 29. The method of claim 28 further comprising the injecting a thermally
- 2 responsive material into the pipe wall between the radially inward tensioned
- 3 support and the inner radially expandable tensioned support.
- 1 30. A method of repairing defects in the wall of a fluid conveying pipe comprising
- 2 the steps of:
- 3 a. Impregnating a tensionable and expandable support with a chemical
- 4 reactant;

- 5 b. tension winding the impregnated support to a reduce diameter while the
- 6 reactant is in a partially cured state;
- 7 c. inserting the tension wound material into a interior annulus of a pipe
- 8 having an interior diameter smaller than the expanding outer diameter of
- 9 the tension wound material;
- 10 d. releasing the tension of the impregnated wound material when at a
- 11 selected location proximate to the pipe defect;
- 12 e. expanding the outer diameter of the repair device to contact the inner
- 13 surface of the pipe wall forming the interior pipe diameter; and
- 14 f. completing the cure of the impregnated chemical reactant.

1 31. The method of claim 30 comprising the further steps of:

- 2 a. using a heat responsive chemical reactant;
- 3 b. incorporating electrically conductive materials into the support;
- 4 c. attaching separable electrically conductive means to the support in
- 5 communication with a electrical power source;
- 6 d. conducting electric current through the conductive material within the
- 7 impregnated support to create heat;
- 8 e. using the heat to complete the cure of the chemical reactant; and
- 9 f. detaching the electric power connectors from the material.

1 32. The method of claim 30 where the chemical reactant is at a B stage at the

2 time of insertion into the pipe.

1 33. The method of claim 30 where the chemical reactant is an ester.

1 34. A method of repairing defects in the wall of a fluid conveying pipe comprising

2 the steps of:

- 3 a. Impregnating a chemical reactant into a tensionable and radially
- 4 compressible coiled support with a annular diameter;
- 5 b. tension un-winding the impregnated support around an outer pipe wall
- 6 having a larger diameter while the chemical reactant is in a partially cured
- 7 state;
- 8 c. releasing the tension of the impregnated wound material when at a
- 9 selected location proximate to the pipe defect; and

- 10 d. completing the cure of the chemical reactant after removing the tensioned
11 force expanding the annular diameter of the support.
- 1 35. An internal pipe support apparatus for minimizing infiltration and exfiltration in
2 underground pipes having interior diameter and a thickness between a first
3 inner surface and a second outer surface and pipe connections comprising:
4 a. an elastic and radially coiled expandable support dimensioned to fit within
5 an interior diameter of the underground pipe under coiled tension;
6 b. an electric heating source;
7 c. means to release the coil tension to allow an outer support surface to
8 expand and circumferentially contact the first inner surface of the pipe;
9 and
10 d. means to remotely provide electric current to the heating source.
- 1 36. The apparatus of claim 35 wherein the support material is the electrical
2 heating source.
- 1 37. The apparatus of claim 35 wherein support contains elongated electrically
2 conductive components.
- 1 38. The apparatus of claim 37 wherein the component is carbon fiber.
- 1 39. The apparatus of claim 37 wherein the support contains one or more heat
2 responsive components.
- 1 40. The apparatus of claim 39 wherein heat responsive component contacts the
2 inner pipe wall surface after tension release.
- 1 41. The apparatus of claim 39 wherein the heat responsive component is a
2 thermoplastic material.
- 1 42. The apparatus of claim 39 wherein the heat responsive component is a
2 thermosetting material.
- 1 43. The apparatus of claim 35 wherein the support is comprised of metal.
- 1 44. The apparatus of claim 35 wherein the support is comprised of resinous
2 elastic material having a matrix memory capability.